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Scientific Paper

Water charging in the State of São Paulo, Brazil (2007–2019): Collected and simulation of uncollected amounts

Cobrança pelo uso da água no Estado de São Paulo, Brasil (2007-2019): Valores arrecadados e simulação de valores deixados de ser arrecadados

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ABSTRACT

Water resource charges are fundamental for monitoring and planning effective actions to conserve, protect, and recover the Water Management Unit (UGRHI). The objective of this work was to analyze the monetary amount collected by the State of São Paulo from 2007 to 2019, considering 20 of the 22 UGRHI. It also aimed to simulate the uncollected amounts by employing three economic indices: the Fiscal Unit of the State of São Paulo (UFESP), the Broad Consumer Price Index (IPCA), and the General Price Index (IGP-M). The analysis indicates that the uncollected amount is between R$ 140 and R$ 170 million, depending on the index assessed, confirming the hypothesis that the adoption of an index would contribute significantly to water resource charges. The collected amounts are essential for investments in the Water Resource Policy of the State of São Paulo. It has not escaped the analysis that, until December 2020, there were still two UGHRI without any collection of charges.

Keywords: water resources management; water resources charges; collected amounts; economic index; environment.

RESUMO

A cobrança pelo uso dos recursos hídricos é fundamental para o monitoramento e planificação de ações efetivas para a conservação, proteção e recuperação das Unidades de Gerenciamento de Recursos Hídricos (UGRHI). O objetivo deste trabalho foi levantar o valor total arrecadado pela cobrança paulista, no período de 2007 a 2019, referente às cobranças de 20 das 22 UGRHI paulistas. Também visou simular os valores que deixaram de ser arrecadados empregando três índices econômicos, a Unidade Fiscal do Estado de São Paulo (UFESP), o Índice de Preços ao Consumidor Amplo (IPCA) e o Índice Geral de Preços - Mercado (IGP-M). A análise mostra que o valor que deixou de ser arrecadado está entre R$ 140 e R$ 170 milhões no período, a depender do índice considerado. Confirma-se assim a hipótese de que a adoção de um índice contribuiria de forma expressiva para a arrecadação da cobrança. Os valores arrecadados são essenciais para os investimentos da Política de Recursos Hídricos no Estado de São Paulo. Não escapou à nossa observação que, até dezembro de 2020, ainda existiam duas UGRHI paulistas sem cobranças implantadas.

Palavras-chave: gestão de recursos hídricos; cobrança pelo uso de recursos hídricos; valores arrecadados; índice econômico; meio ambiente.

INTRODUCTION

Water is essential for life; it is distributed unevenly in time and space. Climatic issues could lead to severe drought occurrences (NOVO, 2019); however, efficient water resources management can contribute positively, especially in critical scenarios (BIAMONT-ROJAS *et al.*, 2023a, 2023c). This is particularly important due to the increasing demand for water by the industry, agribusiness, and population growth (DENNY; GRANZIERA; GONÇALVES, 2020; DA SILVA *et al.*, 2021). According to the Brazilian Water Agency (ANA, 2019), the increasing demand for this resource in the country will escalate up to 24% more by 2030. If this scenario is confirmed, it would result in significantly higher impacts on water quantity and quality (MARTINS *et al.*, 2021). Therefore, conflicts related to multiple uses and distribution of water will escalate (GOMES; SALVADOR; LORENZO, 2021).

To reverse that tendency, more efficient instruments related to water resources management must be implemented, and for that purpose, water charges are highly relevant. Water charging is an instrument accounted for in

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the Brazilian National Water Policy (Federal Law 9.433/1997) (BRASIL, 1997), considered a stimulus for reasonable and sustainable water use to guarantee its multiple uses. Water charging, as an instrument, has its own objectives: i. to recognize water as an economical good and to give users an understanding of its real value; ii. to encourage a reasonable use of water; and iii. to obtain financial means for funding programs and interventions contemplated in water resources plans.

Given its importance, with regard to the objectives, water charging (understood as a management instrument) needs continuous improvement. An additional consideration is the application of principles such as "polluter pays" or "user pays" (LANNA, 2001; ACSELRAD, 2013). More reliable procedures are needed, based on scientific methods, to achieve real advances in water management, resulting in better outcomes for society. Otherwise, there is still a risk that, in people's perception, water charging is merely a taxing instrument.

In Brazil, after more than two decades, different methods of charging have been implemented across the entire federation, highlighting its relevance and irreversibility. Significant advances in national water management have been observed during this time, which would not have been possible without funds from water charging. However, almost all of the committees are not financially sustainable (MORAIS; FADUL; CERQUEIRA, 2018).

Almeida and Curi (2016) demonstrated how beneficial and dynamic water charging can be when well designed and managed:

> […] incorporating various water user profiles […] allows water charging to have not just a money collection objective, but also a role in provoking the reasonable use of water, reducing losses in drinking water supply systems, enhancing the sewage treatment, and discouraging water reservoirs, since they impede the entrance of new users in the basin. (ALMEIDA; CURI, 2016, p. 1004)

Water charging at the Union level was established by the Federal Law nº 9.433/1997, which is considered a management instrument in the National Water Policy (NWP). The concept of water charging introduced in Brazil is based on the French model, established in the Water Act of 1964, although actual collection did not begin until 1968. In the State of São Paulo, water charging began in 2006 for Union resources and in 2007 for State resources. According to article 14 of Decree nº 50.667/2006 (SÃO PAULO, 2006), the process of implementing water charging as an instrument is funded by a technical and financial background study. The basic information to be included in the study is established in Deliberation CRH nº 111/2009 (CRH, 2009).

In terms of economy, water charging collected by the Union has been annually updated according to the Broad Consumer Price Index (IPCA) since 2018. However, there are no mechanisms that "automatically" update the water charging amounts from the State's perspective.

Within the Brazilian context, there are some economic indices employed as tax updating tools for different purposes and sectors. The Broad Consumer Price Index (IPCA) has been the main indicator of inflation in the economy over the established period. In this context, the Brazilian government periodically informs about the macroeconomic data (GARCIA; COSTA, 2023), guiding the fluctuations in family living costs ranging from 1 to 40 minimum salaries (IBGE, 2023). The Fiscal Unit of the State of São Paulo (UFESP) is a value expressed in the national currency (BRL — R$), defined and updated annually according to the accumulated variation of the Consumer Price Index (IPC) relative to the last measurement of the second four-week period of each month. The calculation is performed by the Foundation Institute for Economic Research (FIPE) at the University of São Paulo (USP), based on Article 60 of RICMS/2000-SP. This index is used to upgrade contracts and State taxes (SÃO PAULO, 2023), and even as a limiting tool in water charging collection within the State of São Paulo, according to State Decree nº 50.667/2006 and Deliberation CRH nº 90/2008 (CRH, 2008). The General Price Index (IGP-M) is a monthly index published by the Brazilian Institute for Economy of the Getúlio Vargas Foundation (IBRE-FGV Rio) (IBRE, 2023). This comprehensive price movement indicator covers not only some productive activities but also processes. It is widely used to adjust services billing (energy and phone), rent contracts and services contracts.

In this context, water charging is fundamental for planning and analyzing effective action to conserve, protect and recover the UGRHI. Constant monitoring on the economic approach is also essential due to its link to social and environmental aspects. Despite the water charging approach having been studied and discussed in several previous studies, none of them considered an instrument to keep it up to date in terms of economy. Thus, the idea of applying an economic index must be considered; otherwise, the fundaments should be revised. This revision can cost not just time but also money that could be used in more prioritized subjects within the basin. This study provides crucial information to decision-makers, researchers and the general audience. Additionally, it intends to encourage more trustworthy development plans.

The objective was to quantify the total amount derived from water charging in the State of São Paulo (2007–2019), with regard to 20 of the 22 UGRHI, as well as to simulate the monetary impact due to the absence of an annual adjustment in water charging.

METHODS

This research was developed based on the 21 studies about water charging fundamentals referring to the 22 UGRHIs and legislation analysis in the State of São Paulo. The total amount collected by the water charging, from 2007 to 2019, was analyzed for the state. In total, data on water charging from 20 UGRHIs were obtained from ANA or in the CBH itself in the case of UGRHIs 02/PS, 04/Pardo, 10/SMT e 15/TG (Table 1). It is relevant to mention that UGRHIs 20 and 21 are managed by the same system; thus, the amounts collected by water charging are considered as one unique value.

Based on the data previously mentioned, simulations of the impacts on water charging within each UGRHI were performed due to the absence of a monetary readjustment index. The selection of adjustment indices (IPCA, UFESP, and IGP-M) took into consideration their relevance in inflation readjustment in Brazil. Events such as contract and tax adjustment are achieved by the UFESP; inflation overview and even goal definition by the Central Bank are regulated by the IPCA (BACEN, 2021); finally, rent and service billings are regulated by the IGP-M. The annual and accumulated data from 2007 to 2019 are presented in Table 2, and those values were transformed into accumulated index numbers (Table 3).

Table 1 – Water charging in the State of São Paulo: amounts collected from 2007 to 2019 (R$/mi).

Water charging in the State of São Paulo															
UGRHI	Begin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
01	Jan/18	-	-	-	-	-	-	-	-	-	-	-	0.13	0.17	0.30
02	Jul/07	1.85	2.50	2.63	3.44	3.06	3.45	3.47	3.47	2.74	3.18	3.17	8.43	17.30	58.69
03	NR	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04	Aug/17	-	-	-	-	-	-	-	-	-	-	0.94	2.99	4.85	8.79
05	Jul/07 Apr/16	9.79	11.77	14.78	16.74	16.84	17.67	16.84	13.00	13.17	14.59	15.53	17.35	17.59	195.67
06	May/14	-	-	-	-	-	-	-	15.77	21.71	32.77	33.67	40.04	52.27	196.22
07	Mar/12	-	-	-	-	-	8.80	10.07	10.18	11.12	6.08	8.22	9.11	8.04	71.62
08	Oct/17	-	-	-	-	-	-	-	-	-	-	0.27	0.94	1.48	2.70
09	Dec/17	-	-	-	-	-	-	-	-	-	-	-	3.85	5.21	9.06
10	Nov/10	-	-	-	2.56	6.84	6.88	8.03	5.17	6.98	6.29	8.33	8.06	7.85	66.99
11	Aug/16	-	-	-	-	-	-	-	-	-	0.23	0.68	4.93	5.62	11.46
12	Oct/17	-	-	-	-	-	-	-	-	-	-	0.24	1.48	1.84	3.56
13	Aug/16	-	-	-	-	-	-	-	-	-	5.08	6.82	5.13	6.19	23.22
14	Nov/19	-	-	-	-	-	-	-	-	-	-	-	-	0.22	0.22
15	Apr/18	-	-	-	-	-	-	-	-	-	-	-	2.72	3.02	5.74
16	May/16	-	-	-	-	-	-	-	-	-	1.81	2.59	2.04	2.79	9.22
17	Jul/18	-	-	-	-	-	-	-	-	-	-	-	0.86	2.18	3.04
18	NR	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	Jun/13	-	-	-	-	-	-	2.53	3.16	3.70	5.51	4.47	4.00	2.87	26.24
20	Nov/18	-	-	-	-	-	-	-	-	-	-	-	0.47	1.95	2.42
21	Nov/18	-	-	-	-	-	-	-	-	-	-	-	0.47	1.95	2.42
22	Jun/18	-	-	-	-	-	-	-	-	-	-	-	0.49	1.04	1.52
Total		11.65	14.27	17.41	22.74	26.74	36.80	40.93	50.75	59.43	75.54	84.93	113.50	144.43	699.11

Source: ANA (2021).
UGRHI: Water Management Unit; NR: not registered.

Table 2 – Percentage index (%) for UFESP, IGP-M and IPCA from 2007 to 2019.

Year	UFESP	IGP-M	IPCA
2007	2.15	7.75	4.46
2008	4.57	9.81	5.9
2009	6.52	-1.71	4.31
2010	3.60	11.32	5.91
2011	6.27	5.1	6.5
2012	5.67	7.81	5.84
2013	5.04	5.53	5.91
2014	3.98	3.67	6.41
2015	5.51	10.54	10.67
2016	10.82	7.19	6.29
2017	6.45	-0.53	2.95
2018	2.51	7.55	3.75
2019	3.23	7.32	4.31
2020	4.07	23.14	4.52
Accumulated	**98.21**	**168.84**	**112.66**

Source: IBGE (2023), IBRE (2021) and São Paulo (2023).
UFESP: Fiscal Unit of the State of São Paulo; IGP-M: General Price Index; IPCA: Broad Consumer Price Index.

RESULTS

The data shown in Table 1 indicate that the total amount of water charging collected from 2007 to 2019 was R$ 699.11 million, with these nominal values not adjusted annually for inflation. From this total, UGRHI 06-Alto Tietê was the one that collected the most (R$ 196.22 million), followed by UGRHI 05-PCJ and 07-Baixada Santista, with R$ 195.67 million and R$ 71.62 million, respectively. On the other hand, considering that UGRHIs 03 and 18 have not started with water charging, UGRHIs 14-ALPA and 01-SM collected the lowest values, only R$ 0.22 million and R$ 0.30 million, respectively.

In this context, total values that could have been collected when applying the calculated inflation index corrections are presented in Table 4. Consequently, the amounts not collected in the State of São Paulo are presented in Table 5 for each UGRHI.

According to the results, the amounts that have not been collected by UGRHIs 02, 05, 06, 07 and 10 represent higher values. These values ranged from R$ 14,474,378.01 to R$ 71,392,039.84 when the UFESP index was considered. There was an increase in the simulation values when IPCA was employed, ranging from R$ 15,141,518.04 to R$ 76,281,477.14. Finally, those amounts resulted even higher when the IGP-M was applied, resulting in a range from R$ 17,096,054.62 to R$ 83,721,442.78.

Considering all the UGRHIs in the State of São Paulo, the total amounts not collected according to the simulations were R$ 141,191,325.14; R$ 147,386,850.23; and R$ 170,407,315.00 as per UFESP, IPCA and IGP-M, respectively. It is clear that IGP-M showed the highest value, followed by the IPCA and UFESP, demonstrating an explicit loss due to the absence of an annual inflation adjustment.

DISCUSSION

Water, as a natural resource, requires management strategies that can lead to its preservation and conservation (FERREIRA *et al.*, 2021; BIAMONT-ROJAS; CARDOSO-SILVA; POMPÊO, 2022; BIAMONT-ROJAS *et al.*, 2023a). The various forms and sources from which water is available for different uses, whether natural or human-created, are under threat (CARDOSO-SILVA *et al.*, 2021; BIAMONT-ROJAS *et al.*, 2023b).

Table 3 – Annual and cumulative indices for UFESP, IGP-M and IPCA from 2007 to 2019.

Year	UFESP		IGP-M		IPCA	
	Annual	Accumulated	Annual	Accumulated	Annual	Accumulated
2007	1.0215	1.0215	1.0775	1.0775	1.0446	1.0446
2008	1.0457	1.0682	1.0981	1.1832	1.0590	1.1062
2009	1.0652	1.1378	0.9829	1.1630	1.0431	1.1539
2010	1.0360	1.1788	1.1132	1.2946	1.0591	1.2221
2011	1.0627	1.2527	1.0510	1.3606	1.0650	1.3015
2012	1.0567	1.3238	1.0781	1.4669	1.0584	1.3776
2013	1.0504	1.3905	1.0553	1.5480	1.0591	1.4590
2014	1.0398	1.4458	1.0367	1.6049	1.0641	1.5525
2015	1.0551	1.5255	1.1054	1.7741	1.1067	1.7181
2016	1.1082	1.6906	1.0719	1.9017	1.0629	1.8262
2017	1.0645	1.7997	0.9947	1.8915	1.0295	1.8801
2018	1.0251	1.8449	1.0755	2.0344	1.0375	1.9506
2019	1.0323	1.9045	1.0732	2.1833	1.0431	2.0347
2020	1.0407	1.9821	1.2314	2.6884	1.0452	2.1266

Source: IBGE (2023), IBRE (2021) and São Paulo (2023).
UFESP: Fiscal Unit of the State of São Paulo; IGP-M: General Price Index; IPCA: Broad Consumer Price Index.

Table 4 – Real amount collected and simulation totals when inflation indices are applied for each Water Management Unit. Values given in local currency (BRL-R$).

UGRHI	Real amount	Collected+UFESP	Collected+IPCA	Collected+IGP-M
01	298,445.80	302,740.00	304,176.59	308,176.05
02	58,685,160.71	73,159,538.72	74,137,398.37	75,781,215.33
03	-	-	-	-
04	8,786,296.36	8,937,782.19	8,992,707.68	9,150,580.35
05	195,674,731.60	267,066,771.44	271,956,208.74	279,396,174.38
06	196,221,265.48	214,018,771.28	213,351,639.55	219,885,633.00
07	71,615,072.84	86,731,093.20	86,756,590.88	89,110,495.29
08	2,695,344.13	2,741,477.60	2,758,123.87	2,805,883.36
09	9,064,770.57	9,189,205.51	9,230,834.25	9,346,728.20
10	66,993,472.76	83,033,399.00	83,642,056.77	85,822,195.17
11	11,457,723.39	11,685,764.12	11,752,422.85	11,957,416.53
12	3,563,266.35	3,625,262.03	3,647,099.19	3,709,174.92
13	23,216,404.56	24,421,730.87	24,577,874.06	25,395,820.04
14	222,840.05	222,840.05	222,840.05	222,840.05
15	5,736,014.17	5,823,742.16	5,853,090.87	5,934,797.36
16	9,221,065.05	9,666,240.16	9,727,819.70	10,036,628.27
17	3,040,807.25	3,068,552.70	3,077,834.72	3,103,675.77
18	-	-	-	-
19	26,242,379.82	30,185,216.46	30,071,459.02	31,070,124.42
20/21	2,423,626.88	2,438,870.04	2,443,969.52	2,458,166.42
22	1,524,056.87	1,539,829.09	1,545,105.56	1,559,795.20
Total	**699,106,371.52**	**840,297,696.67**	**846,493,221.76**	**869,513,686.53**

UGRHI: Water Management Unit; UFESP: Fiscal Unit of the State of São Paulo; IGP-M: General Price Index; IPCA: Broad Consumer Price Index.
Source: ANA (2021).

Table 5 - Amounts not collected by each Water Management Unit and comparison of the three inflation indices. Values given in local currency (BRL-R$).

UGRHI	UFESP	IPCA	IGP-M
01	4,294.20	5,730.79	9,730.25
02	14,474,378.01	15,452,237.66	17,096,054.62
03	-	-	-
04	151,485.83	206,411.32	364,283.99
05	71,392,039.84	76,281,477.14	83,721,442.78
06	17,797,505.80	17,130,374.07	23,664,367.52
07	15,116,020.36	15,141,518.04	17,495,422.45
08	46,133.47	62,779.74	110,539.23
09	124,434.94	166,063.68	281,957.63
10	16,039,926.24	16,648,584.01	18,828,722.41
11	228,040.73	294,699.46	499,693.14
12	61,995.68	83,832.84	145,908.57
13	1,205,326.31	1,361,469.50	2,179,415.48
14	-	-	-
15	87,727.99	117,076.70	198,783.19
16	445,175.11	506,754.65	815,563.22
17	27,745.45	37,027.47	62,868.52
18	-	-	-
19	3,942,836.64	3,829,079.20	4,827,744.60
20/21	15,243.16	20,342.64	34,539.54
22	15,772.22	21,048.69	35,738.33
Total:	**141,191,325.14**	**147,386,850.23**	**170,407,315.00**

UGRHI: Water Management Unit; UFESP: Fiscal Unit of the State of São Paulo; IGP-M: General Price Index; IPCA: Broad Consumer Price Index.
Source: ANA (2021).

Negative impacts resulting from geogenic events (erosion, weathering, precipitation, among others) and anthropogenic activities (mining, cattle ranging, agriculture, etc.) can restrict access to these sources (MATAMET; BONOTTO, 2019; BROUSETT-MINAYA *et al.*, 2021; FONTANA *et al.*, 2022). Effective management addresses these threats by promoting plans for the conservation and preservation of some strategical sites in the basin. All these efforts can lead to the creation or modification of policies at different levels (national, state or municipal) based on available data (FRASCARELI *et al.*, 2018; DE ALBUQUERQUE *et al.*, 2021; DE SOUSA *et al.*, 2021).

The implementation of the National Water Policy in Brazil considers a complex system involving the federal, state and municipal governments, accompanied by water users and organized civil society (GUTIÉRREZ, 2010; ELABRAS VEIGA; MAGRINI, 2013; BARBOSA; ALAM; MUSHTAQ, 2016). Water charging is included because it funds the activities needed to develop new strategies to conserve and preserve water (BRAGA; STRAUSS; PAIVA, 2005; FORMIGA-JOHNSSON; KUMLER; LEMOS, 2007; DE BRITO; DE AZEVEDO, 2020). However, the economic factor plays an important role, and its updating along time should be on the agenda of decision-makers (PORTO, 1998; MACHADO *et al.*, 2019; ROCHA *et al.*, 2023).

CONCLUSIONS

Significant values were reported based on the non-collected amounts for each UGRHI for the period assessed, revealing a monetary loss by the State of São Paulo. IGP-M simulation showed the highest difference along the years evaluated in this research.

There are still two UGRHIs in the State of São Paulo that, until December 2020, had not started charging for water. This situation created a gap when comparing the efficiency of charging, which also extends to longer periods of collection.

Water charging, along with other costs that impact household budgets and production chains, causes concern and creates political tension. However, decision-makers should analyze it more carefully, considering increasing threats to water resources each year.

Water charging for agricultural activities has not yet been regulated in the State of São Paulo. The inclusion and regulation of this activity will enhance water charging and, consequently, investments in water management in the State of São Paulo.

AUTHORS' CONTRIBUTIONS

Magro, S.A.: Conceptualization; Data Curation; Formal Analysis; Investigation; Methodology; Validation; Writing – Original Draft; Writing – Review & Editing. de Lima, F.A.: Formal Analysis; Methodology; Writing – Original Draft. Biamont-Rojas, I.: Formal Analysis; Methodology; Validation; Writing – Review & Editing. Almeida, L.: Formal Analysis; Writing – Original Draft. Gomes, F.C.: Data Curation; Formal Analysis; Writing – Original Draft. Gamero Guandique, M.E.: Data Curation; Formal Analysis; Methodology; Validation; Writing – Original Draft.

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